

# GVPM Energy Storage Overview Mr. David Skalny & Dr. Laurence Toomey

10 August 2011

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## **Energy Storage**





#### Challenges we have:

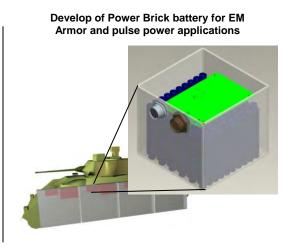
- Delivering reliable battery solutions in standardized military form factors
- Safety Understanding thermal runaway process and its control, improved BMS and alternative cell technologies.
- Developing energy storage systems with higher energy and higher power densities (focus on designs and chemistries).
- Manufacturing process development, quality and cost control.

#### Solutions we are investigating:

Development of advanced manufacturing technologies & form factor standardization

Lilon Battery Demo

Automated Manufacturing Process





#### Where we need your help:

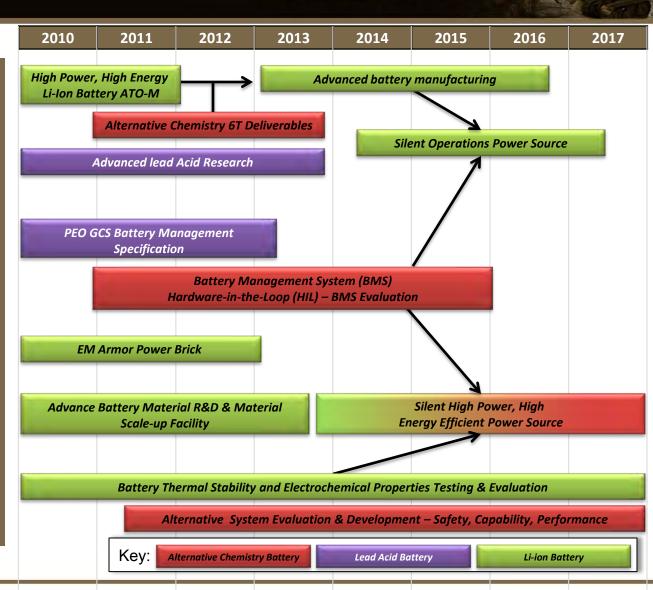
- Identify materials/designs/technologies to significantly improve safety
- Develop technologies to improve both energy and power density as well as life (calendar and cycle).
- Develop energy storage systems that focus on standardized form factors (6T, 4HN, Group 31 and Group 34).
- Cost reduction technologies



# Projects Current & Future



- Manufacturable,
   Affordable, Safe,
   Reliable, Standardized
   High Energy Battery
   Packs
- Battery ElectronicsControl & Management
- High Power Batteries
- Ultra High Power & High Energy
- In house Research, Test,& Evaluation Capability





## Laboratory Capability Current & Future



### **Current Capability**



Battery Testing & Pre-Qualification



### **GSPEL**

Ground Systems Power and Energy Laboratories

Battery Technology Roadmap

### **Future Capability**



Battery Pack Storage & Shelf Life Testing



Battery Management Electronics Laboratory



GSPEL Battery Test Chambers

- Advanced Battery Testing and R&D
- Lead Acid Battery Laboratory (Bldg 7) Supports testing and pre-qualification for military lead acid batteries; 6 water baths, 31 circuits, 1 thermal chamber
- Electrochemical Research & Analysis Lab (EARL) Supports small scale testing for advanced battery
  chemistries (Li-ion, Ni-Zn) at the cell and module level
  & battery R&D projects; Walk-in fume hood for safety,
  2 explosion resistant thermal chambers, 15 circuits.

- **GSPEL Battery Chambers** 3 Interior & 3 Exterior for safe testing from battery cell to pack level.
- Battery Management Electronics Lab TRL BMS evaluation, Hardware-in-Loop simulation.
- Battery Storage & Shelf Life Testing storage capacity for 26 battery packs or 600 6T batteries

## Advanced 6T Battery Roadmap





Military Lead-Acid 6T Batteries 40Wh/kg

> 400W/kg ~\$350-400/kWh

> Baseline



Advanced (Ni-Zn or Li-ion) 12V 6T Battery

> 50-60Wh/kg 400-450W/kg >\$2000/kWhr

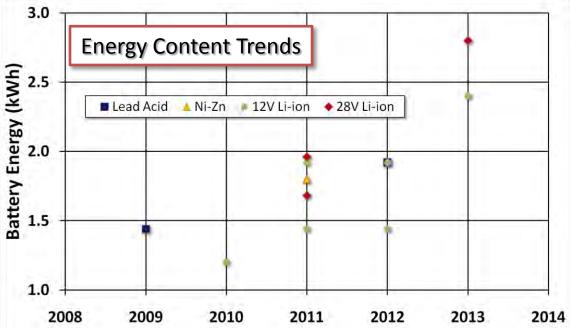
**Lighter, 33% More Energy** 



Li-ion Military Battery Pack Target

- >90Wh/kg
- >920W/kg
- <\$800/kWhr

2-for-1 Drop-in Replacement ½ Volume



Year

Advanced Batte	ry Technologies	Price Targets
		Long-Term

	Battery Technology	Near-Term	Mid-Term Production	Long-Term High Volume
	Lead Acid (12V)	\$400/kWh	\$350/kWh	\$250/kWh
	Ni-Zn (12V)	\$500/kWh	\$350/kWh	\$200/kWh
	Li-ion (12V or 28V)	\$5,000/kWh	\$1,000/kWh	\$500/kWh